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26th March, 1975

The Director,
Department of Mines,
Box 38, Rundle Street P.O.,
ADELAIDE, SA 5000

Attention: R.B. Major.

REPORT MP 3305/75

YOUR REFERENCE:	Application dated 17-3-75
MATERIAL:	33 rock specimens
LOCALITY:	Mt. Painter area. North Flinders Range, South Australia (Mt. Gee Formation)
IDENTIFICATION:	P1529-1561/75 TS 14082-14114
DATE RECEIVED:	18-3-75
WORK REQUIRED:	Petrographic description, determination of origin where possible and the nature and relationship of minerals.

Investigation and report by: Sylvia Whitehead

Officer in Charge, Mineralogy/Petrology Section: Dr K.J. Henley

K. J. Henley
for F.R. Hartley
Director

mhb

1. SUMMARY

P1629/75 RS114
TSC14082
No. 6 workings

Silicified, hematite-bearing breccia which once contained abundant microcline. The extensive silicification has obliterated evidence of origin.

P1630/75 RS115
TSC14083
North face of The Armchair

Leuco-granodiorite with encrusting breccia. The granitic rock is mainly quartz and plagioclase but the breccia contains some microcline, muscovite and heavy mineral grains. The breccia is probably sedimentary.

P1631/75 *Arkosic breccia* RS116
TSC14084
Mt. Gee Prospect.

Breccia containing two phases of different composition although both contain fragments of quartz, microcline and altered mica. It was probably sedimentary.

P1632/75 RS117
TSC14085
Mt. Gee Prospect.

Partly silicified, hematite-rich breccia with a trace of malachite. Much of the matrix has been replaced by quartz and its origin cannot be determined from the thin section.

P1633/75 RS118
TSC14086
Red brown tillite

Quartzose greywacke composed of poorly sorted quartz, feldspar and lithic fragments. There is no evidence of metamorphism

P1634/75 RS119
TSC14087
Mt. Gee Prospect

Silicified hematitic breccia. It is now composed of quartz and hematite with minor clay and a trace of monazite. It once contained feldspar. A sedimentary origin is probable but proof is lacking.

P1535/75
TSC14088 ^{RS120}
North of Mt. Ward

Arkosic breccia containing relatively large angular fragments mainly of quartz and microcline in a matrix of well sorted, arkosic sandstone. It is cemented mainly by authigenic chlorite and contains a trace of interstitial fluorite. There is no evidence of metamorphism.

P1536/75
TSC14089 ^{RS121}
East of Mt. Painter

Silicified fine-grained layered sediment showing evidence of graded bedding. It is now a mosaic of quartz crystals stained with orange and red ferric oxide. The possibility that it was or contained carbonate cannot be excluded.

P1537/75
TSC14090 ^{RS122}
Hematite Valley Prospect

Recrystallized hematitic and feldspathic sandstone. It was a poorly sorted sandstone composed of quartz, feldspar and lithic grains cemented mainly by overgrowth quartz which has probably recrystallized. Specular hematite (fragments?) are scattered throughout the rock. A few grains have been replaced by ochreous hematite.

P1538/75
TSC14091 ^{RS123}
East Painter No. 4 adit

Weathered hematitic breccia with a possible siltstone matrix. Clasts are mainly of coarse-grained quartz and microcline. There has been some tectonic fracturing. Traces of torbernite have replaced a few grains 1-2 mm in size and filled very few small voids. Some is associated with clay in weathered clasts.

P1539/75
TSC14092 ^{RS124}
East Painter No. 4 adit

Hematitic breccia. A fragmental rock of undetermined origin has been replaced by hematite, quartz and pyrite. Some pyrite has been leached and/or replaced by jarosite. Torbernite encrusts a weathered surface and fills some voids.

P1540/75
TSC14093 ^{RS125}
Mt. Painter Summit

Breccia composed of rock which has been replaced by quartz and hematite. The general appearance suggests a tectonic breccia but conclusive evidence is lacking. The matrix, heavily stained by ochreous hematite shows evidence of silicification.

P1541/75 RS126
 TSC14094
 NE Slope Mt. Painter.
 @ Mt. Gee quartz hematite sect

Silicified fine-grained sediment in which some layers contain fragments of specular hematite and very few other heavy mineral grains mainly monazite, zircon and rutile. In one layer these are concentrated in hollows between small ripple marks, confirming that the specular hematite was of clastic sedimentary origin.

The sediment may also have contained some gypsum? or other evaporite mineral.

P1542/75 RS127
 TSC14095
 East Painter "dyke"
 in Heighly Creek

Breccia probably of sedimentary origin. The large clasts were derived from rock composed mainly of quartz and microcline with minor muscovite.



The matrix contains an abundance of ?clastic hematite as well as quartz, microcline, muscovite and a few monazite fragments.

P1543/75 RS128
 TSC14096
 Contact hematite breccia
 of granitic breccia above
 No. 1 workings, East Painter

Breccia with clasts mainly of microcline and quartz but with a few of quartzite?

The matrix contains specular hematite and minor muscovite and microcline. All other constituents of the matrix have been replaced by quartz which fills all interstices and encloses the hematite and microcline.

P1544/75 RS 129
 TSC14097
 Purple granitic breccia
 Haemahata Valley

Silicified breccia in which the matrix has been replaced by quartz but retains some hematite marking relict textures. One well rounded grain of graphic quartz-microcline intergrowth was found.

P1545/75 RS 130
 TSC14098
 Purple granitic breccia
 Haemahata Valley

Weathered breccia composed largely of quartz, microcline, hematite with sericite and clay but also containing a few "foreign" fragments of much finer grained rock which suggests a sedimentary origin. The matrix has been partly replaced by quartz and some secondary feldspar.

P1546/75, RS 131
 TSC14099
 Dyke north of Haemahata
 Valley Prospect

Breccia containing clasts composed of coarse-grained quartz and minor muscovite in a matrix which has been almost completely replaced by specular hematite and quartz. The breccia was probably of sedimentary origin.

P1547/75
TSC14100 RS 132

*Yudnamutana Gorge
At water hole near mouth of Gorge*

Breccia of undetermined origin composed mainly of microcline and quartz. There is some evidence of fracturing possibly after the breccia formed but extensive weathering has obliterated much of the detail of textures.

P1548/75
TSC14101 RS 133

*Near mouth Yudnamutana Gorge
Field brown red (leuc granite
or volcanic)*

Formerly a medium-grained quartz-feldspar rock probably containing abundant potash feldspar. It also had some opaque oxide (magnetite) associated with zircon and monazite? and may have been an acid gneiss or a pegmatitic rock (compare sample P1549/75).

All silicates including feldspar have been completely altered and replaced by microcrystalline to cryptocrystalline quartz stained by red iron oxide.

P1549/75
TSC14102 RS 134

Top of The Armechan

Acid gneiss or pegmatite composed of quartz and microcline. It is of interest that the grain size and interrelated textures are very similar to those in sample P1548/75 but, in this sample instead of red-stained, secondary, microcrystalline quartz there is red-stained microcline. There is some evidence of tectonic stress.

P1550/75
TSC14103 RS 135

GJA.

Fractured and weathered breccia composed of quartz and microcline. Its origin cannot be determined from the hand specimen or thin section. Quartz has migrated, recrystallized and replaced parts of the rock.

P1551/75
TSC14104 RS 136

GJA.

Arkosic breccia showing evidence of regrowth of both microcline and quartz. There is very tenuous evidence for a sedimentary origin but it is not conclusive.

P1552/75
TSC14105 RS 137

GJA.

Weathered granitic gneiss or acid gneiss composed of quartz and completely weathered feldspar probably microcline. Textures are similar to those in samples P1548 and 1549/75. and it has probably had a similar history.

P1553/75
TSC14106 RS 138

GJA.

Partly recrystallized arkosic sandstone probably originally a well sorted sediment.

It is of interest that, where quartz grains have coalesced, they have formed very irregular

and embayed patches which are similar to quartz aggregates found in samples P1548, 1549 and 1552/75. This may provide a clue to the origin and history of these rocks and photomicrographs for comparison may be advantageous when time permits.

P1554/75 GJA
TSC14109 RS139

Acid gneiss in which the dominant feldspar is albitic plagioclase. Some textural evidence suggests derivation from a feldspathic sandstone.

Veins contain quartz and fluorite and adjacent to fractures microcline has replaced some plagioclase.

P1555/75
TSC14108 RS140

*East Pawler
No. 5 adit*

Hematitic siltstone containing thin parallel layers which show graded bedding. Quartz and some other mineral grains now replaced by sericite and clay were of clastic sedimentary origin and therefore this is not banded iron formation in the accepted sense. Conclusive evidence was not found to indicate the origin of the abundant hematite which is uniformly distributed.

P1556/75
TSC14109 RS141

Acid gneiss with evidence of broad banding or layering. Variations in grain size and composition in different layers suggest a sedimentary origin but the evidence is not absolutely conclusive and the continuity of the layering in the field should be considered.

P1557/75 DJF
TSC14110 RS142

*East Pawler
No. 5 adit*

Hematite-bearing siltstone and sandstone probably related to sample P1555/75. Quartz and other mineral grains were of clastic sedimentary origin but the origin of the hematite could not be determined with certainty.

P1558/75 DJF
TSC14111 RS143

Radwin Ridge

Feldspar (plagioclase)-biotite schist in which textures have been modified by later crushing or shearing. It was probably a sediment (argillaceous?) but whether the large plagioclase crystals were clasts or porphyroblasts is not clear.

P1559/75 DJF
 TSC14112 RS144
 Western end Radium Ridge

Quartz-feldspar-biotite schist. It differs from sample P1558/75 in that the feldspar in the finer grained matrix is microcline not plagioclase. The large crystals are plagioclase porphyroblasts? modified by crushing or shearing as in P1558/75 and they do not appear to represent pebbles.

If this were a conglomerate, quartz pebbles would be expected but were not found.

P1560/75 DJF
 TSC14113 RS145
 Breccia knob

Breccia almost certainly of sedimentary origin. It is composed largely of quartz and microcline with additional mica, hematite and interstitial argillaceous material in the matrix. There are a few pockets of siltstone confirming a sedimentary origin.

P1561/75 DJF
 TSC14114 RS146
 Radium Ridge

Breccia probably of sedimentary origin. The larger clasts show variations in composition and texture and were not all derived from the same zone of rocks. Some grain boundaries are now indistinct as a result of weathering.

DESCRIPTION OF BRECCIAS AND RELATED ROCKS FROM THE MOUNT PAINTER
AREA, NORTH FLINDERS RANGES

2. DESCRIPTION OF SAMPLES

Sample: P 1529/75, R.B.M. 2/75, TSC14082
RS 114

Location:

North Flinders Run 17, Photo No. 090, Sample Locality (12)^{sp}
No. 6 Workings

Rock Type:

Hematite and monazite-bearing, silicified rock.

Hand Specimen:

A massive medium-grained siliceous rock containing moderately abundant hematite mainly as crystalline aggregates. Portion of the cut surface shows a very indistinct suggestion of banding or layering and this is emphasized when the surface is etched with hydrofluoric acid and stained for potash feldspar. There is however no clear evidence to suggest the origin of this banding or streaking.

Thin Section:

A visual estimate of the minerals present is as follows:

	<u>%</u>
Quartz	50-60
Microcline	20-30
Secondary mica and clay	5-10
Hematite	10-15
<u>Monazite</u>	trace-1
<u>Zircon</u>	minute trace
Oxidized pyrite?	1-2 (possibly more)
<u>Rutile?</u>	trace

Much of this rock has been replaced by intergrown quartz crystals which vary in size up to 2 mm and this quartz has crystallized across much of the earlier rock. Included within this quartz there are numerous aggregates, groups and thin bands (possibly former colloform bands) of specular hematite and locally this hematite is associated with scattered crystals of monazite, which vary in size up to 0.4 mm. Some of this monazite appears to have been fractured and invaded by the replacing quartz and other smaller grains and fragments are now included within the replacing quartz.

Some aggregates of hematite crystals included within the replacing quartz outline the crystal form of earlier minerals which have been replaced and some of these crystals

were 1-2 mm in size. One patch of hematite shows an external shape typical of an amphibole cross section but this suggestion must remain tentative as there are other possibilities.

Portion of the section contains a mass of turbid, medium-grained microcline which has been extensively veined and partly replaced by quartz. Reddish-brown iron oxide has accumulated along some cleavage planes and grain boundaries in this mass of microcline. *This iron oxide gives red colour around margins of microcline as seen in hand spec.*

In other zones the replacing quartz contains irregular patches and clouds of fine-grained yellowish to pale green secondary mica and probably some clay and/or chlorite and some of this secondary silicate is heavily stained by dark reddish-brown iron oxide. From available evidence it is not possible to determine the identity of the mineral now replaced by this mica and secondary quartz but in one area it encloses an aggregate of monazite crystals 0.5 mm in size.

There are a few opaque to translucent dark red iron oxide pseudomorphs which could be oxidized crystals of pyrite and there are very few fractured crystals of a titanium mineral which may be rutile.

Inferred Origin:

It is not possible to determine the ultimate origin of this rock from available evidence. It formerly was composed largely of medium-grained microcline associated with other silicate minerals, some monazite and possibly some carbonate and/or amphibole. It has been extensively replaced by moderately coarse-grained quartz and specular hematite some of which marks relict textures of earlier minerals. It probably also contained some pyrite and this has also been fractured and veined by the replacing quartz.

From a study of the hand specimen and the thin section it is not possible to determine the nature of the breccia or any contact as most of the details of texture have been obliterated by the secondary quartz.

Sample: P1530/75, R.B.M. 4/75, TSC14083

RS 115

Location:

North Flinders Run 18, Photo No. 08, Sample Locality (13)_{SP}
 "The Armchair". *northern face.*

Rock Type:

Leuco-granodiorite with encrusting breccia.

Hand Specimen:

Most of the sample is a moderately coarse-grained very pale pink granitic rock and one surface is encrusted with a layer up to 2 cm thick of finer grained breccia stained a darker red to grey.

Staining tests for feldspar on the coarse-grained rock show very little potash feldspar and an abundance of plagioclase.

Thin Section:

A visual estimate of the minerals present is as follows:

	<u>%</u>
<u>Granitic Rock</u>	
Quartz	40-50
Microcline	3-5
Plagioclase	40-45
Muscovite	2-3
Opaque oxide/sphene	trace
Apatite	trace

The encrusting breccia contains quartz, microcline, sericitized and extensively altered and stained feldspar, minor muscovite, opaque oxide, rutile and traces of tourmaline and zircon.

The granitic rock is composed of coarse grained quartz irregularly intergrown with coarse-grained plagioclase and minor microcline and many grain boundaries are very irregular possibly due to replacement or reaction. Some plagioclase crystals have been partly replaced by moderately fine-grained muscovite.

Contact between the granitic rock and the encrusting breccia is sharply defined and for most of the distance is marked by a small fracture. Locally however, the breccia appears to be cemented onto the granitic rock.

The breccia consists of closely packed angular fragments of quartz, microcline and extensively altered feldspar with a few flakes of muscovite and very few heavy mineral grains. Adjacent to the contact the size of these fragments is very small and averages 0.1 mm in size but there is an increase in the size of fragments away from the contact. There are also a few lithic fragments up to 5 mm in size composed mainly of quartz and feldspar. Some interstices contain iron oxide-stained sericitic material and heavily stained clay? but the breccia appears to be cemented mainly by quartz with some thin overgrowths of secondary potash feldspar around microcline grains or fragments.

In the finer grained zone adjacent to the contact muscovite flakes and some other elongate fragments in this breccia show some evidence of subparallel orientation and this, together with the progressive change in grain size is more suggestive of a sedimentary than a tectonic breccia. It is also clear from the composition of the breccia that the mineral fragments have not all been derived from a rock type represented by the granodiorite which the breccia is encrusting.

Inferred Origin:

The granitic rock has had a complex history and no evidence remains from which to determine its exact origin. Many textures indicate reaction and possibly replacement.

The breccia encrusting the granodiorite has a different composition and all available evidence suggests that it was of sedimentary origin.

Sample: P1531/75, R.B.M. 15/75, TSC14084.

RS 116

Location:

North Flinders ^{Enlargement} Run 17 Photo No. 090, Sample No. ^{locality} (31)_{sp}
Mt. Gee. ^{Prospect!}

Rock Type:

Arkosic breccia partly silicified, probably of sedimentary origin.

Hand Specimen:

A pink and dull green fine to medium-grained rock with a confused and fragmental texture. It contains one band or layer 2-3 cm thick composed largely of pink feldspar and probably quartz and this is in contact with another layer containing abundant olive green mica and clay with a few fragments of pink rock.

Thin Section:

A visual estimate of the constituents is as follows:

	<u>%</u>
Quartz	40-50
Microcline	15-20
Sericitized feldspar	3-5
Mica flakes	1-2
Secondary mica, chlorite and clay	20-30 (more locally)
Opaque oxide and leucoxene	1-2
<u>Oxidized pyrite</u>	trace
<i>detrital</i> { <u>Monazite</u>	trace
{ <u>Zircon</u>	minute trace
{ <u>Rutile</u>	trace

All phases or bands in this sample contain fragments 0.1-2 mm in size of turbid microcline, quartz, altered biotite, muscovite and sericitized minerals and there are also some larger lithic fragments most of which are composed of intergrown quartz and potash feldspar with and without altered mica. The dull green band or layer also contains portion of a large fragment now composed of chlorite and sericite with numerous spots of secondary ferric oxide staining and this fragment contains some small grains of rutile, one of monazite, very few small zircon grains and a metamict mineral. The chlorite and sericite which have replaced this fragment show parallel orientation but it is not clear whether this is an altered schist or an altered large crystal which had good cleavage. This green chloritic or clay-rich layer also contains a few small fragments of monazite and more abundant altered mica than the pink layer.

In both phases the fragments appear to be very poorly sorted varying in size from <0.1 mm to several millimetres and in the green chloritic or clay-rich layer they appear to be more loosely packed than in the pink layer. In the green layer the fragments are cemented by altered mica and chlorite and orange to brown-stained clay and in general this layer appears to have contained a much higher proportion of micaceous and argillaceous material. There are also some deformed and partly to extensively altered flakes of mica up to 2 mm long and most of these are approximately parallel to the contact between the two layers or phases giving it the appearance of a sediment. The pink layer contains much less altered mica, chlorite and clay and it appears to have been cemented and also partly replaced by secondary or migratory quartz some of which has crystallized across the earlier fabric in a similar manner to that in sample P1529/75. This has obscured

and/or obliterated much of the fine detail but locally fragments of quartz, microcline and also some of hematite are cemented by orange to brown-stained clay, fine-grained mica and sericitic material. This band or layer contains more abundant large fragments over 5 mm in size composed mainly of quartz and microcline with some altered mica and these fragments may have been derived from acid gneiss. One apparently rounded and fractured zircon grain was found in this band and a few of the lithic and feldspar fragments appear to have been partly rounded but how conclusive this evidence is, is not certain.

There are a few iron oxide pseudomorphs after pyrite crystals 2 mm in size mainly in the pink phase.

Inferred Origin:

It is suggested that the micaceous and clay-rich green layer or phase was almost certainly of sedimentary origin and although a sedimentary origin is also favoured for the pink layer the evidence is less conclusive and other interpretations are possible. If this also is of sedimentary origin the grains and fragments have not been transported any great distance.

Sample: P1532/75, R.B.M. 16/75, TSC14085.

RS117

Location:

North Flinders Run 17, Photo No. 090, Sample Locality (33)_{sp}
Mt. Gee. Prospect. *Enlargement*

Rock Type:

Partly silicified hematite-rich breccia with a trace of malachite.

Hand Specimen:

A medium to coarse-grained breccia containing some pink feldspathic fragments and dull green chloritic fragments in a dark coloured matrix which contains abundant specular hematite. Traces of malachite occur in a few small voids.

Thin Section:

A visual estimate of the constituents is as follows:

	<u>%</u>
Quartz	40-50
Hematite	15-20 (more locally)
Altered microcline	10-15 (varies)
Chlorite	10-15
Muscovite	3-5
<u>Monazite</u>	1-2
<u>Rutile</u> } <i>detrital</i>	trace
<u>Oxidized pyrite</u> } <i>fourmaline</i>	trace

This rock has been extensively replaced by medium to coarse-grained quartz and specular hematite and this has obliterated much of the earlier texture. One zone contains a mass of intergrown microcline crystals with minor opaque oxide, leucoxene and muscovite and this is in contact with a mass of slightly deformed and altered medium-grained muscovite which encloses or contains a few crystals or fragments of monazite and some small patches of chlorite.

In other zones a mosaic of coarse-grained quartz has crystallized across, and contains a few angular fragments of turbid microcline, very numerous aggregates and fractured fragments of specular hematite, some angular fragments of monazite and very few fragments of tourmaline. It is clear that some fracturing has occurred after crystallization of the specular hematite and this fracturing has been healed by crystallization or recrystallization of the quartz. There are also some zones where interstices between fragments of hematite, mica, plagioclase and monazite now contain fine-grained chlorite.

Origin and History:

It is not possible to determine the origin of this rock from the thin section. At one time it contained some medium to coarse-grained microcline, mica and probably some monazite. It was extensively replaced by specular hematite possibly accompanied by quartz and minor amounts of pyrite. Fracturing occurred after crystallization of the hematite and following this there was either some additional silicification or mobilization and recrystallization of the quartz. Pyrite has been oxidized and there are also traces of secondary copper-bearing carbonate.

This is the simplest interpretation of the available evidence but it is possible that the history has been even more complex.

Sample: P1533/75, R.B.M. 18/75, TSC14086.
RS118

Location:

North Flinders, ^{Enlargement} Run No. 17, Photo No. 090, Sample Locality (48)_{SP}
Mt. Gee. Prospect^A

Rock Type:

Mainly quartzose greywacke.
Contact of red brown feldite and pink arkosic breccia

Hand Specimen:

The bulk of the sample is a greyish-red fine-grained rock which contains scattered larger fragments and some well-

rounded pebbles up to 4 cm in size. Along one side of the sample there is a zone of paler coloured fragmental rock.

Thin Section:

A visual estimate of the constituents is as follows:

	<u>%</u>
Detrital quartz	40-45
Detrital feldspar	5-10
Lithic grains and fragments	10-15
Opaque oxide and leucoxene <i>rutile</i>	trace
Garnet grains	minute trace
Interstitial mica, clay and quartz	30-35

Most of the sample is a dark red, iron oxide-stained greywacke which is composed of poorly sorted subangular and subrounded quartz grains, subangular and angular feldspar grains and some lithic grains and fragments which vary in composition and in degree of rounding. These detrital grains and fragments vary in size from <0.05 mm to large lithic grains and fragments over 5 mm in size. They are fairly loosely packed and are cemented by a fine-grained matrix containing some very small quartz grains or fragments, very fine-grained mica and some sericite or argillaceous material stained by ferric oxide.

The lithic grains and fragments vary in composition and include some well-rounded grains composed mainly of fine-grained mica which may have been derived from schist, some rounded grains of acid? volcanic rock and some composed of fine-grained mica and quartz. There are also larger and generally angular or subangular fragments composed of coarse grained microcline with and without quartz and muscovite. These have been derived from granitic or gneissic rocks and have not been transported as far as the finer grained detrital material.

The paler coloured layer or zone contains similar detrital material with a slightly higher proportion of larger lithic grains and a coarser grained matrix. There are also more abundant heavy mineral grains mainly opaque oxide and rutile averaging 0.1 mm in size in the matrix and less very fine-grained iron oxide. There are a few moderately fresh biotite flakes up to 1.5 mm long almost parallel to the contact between the zones. This contact is poorly defined in the thin section.

Origin and History:

This is a poorly sorted sediment composed predominantly of material derived from granitic or gneissic rocks. There has been some welding and very minor interpretation of grains but no evidence of metamorphism. *interpenetration?*

Sample: P1534/75, R.B.M. 19/75, TSC14087.

RS119

Location:

North Flinders, ^{Enlargement} Run No. 17, Photo No. 090, Sample Locality (4)₅
Mt. Gee. Prospect

Rock Type:

Silicified hematitic breccia.

Hand Specimen:

A massive fine to medium and locally coarse-grained rock showing a confused and patchy distribution of specular and red ochreous hematite and quartz. There are a few minor patches of clay possibly with some sericite.

Thin Section:

A visual estimate of the constituents is as follows:

	<u>%</u>
Quartz	65-75
Hematite	20-30
<u>Monazite</u>	trace
Clay	3-5

The rock is now composed largely of an uneven mosaic of medium to coarse-grained quartz with a few patches of finer grained quartz and including some well formed quartz crystals. This has crystallized across the earlier rock fabric and it contains numerous crystals and fragments of specular hematite and patches of ochreous hematite and also a few angular fragments of monazite. In some places earlier textures and former mineral grains are outlined by fine-grained hematite and there are some former fragments 0.5 to over 5 mm in size which have been replaced mainly by red ochreous hematite associated locally with some quartz and possibly with some argillaceous material. Although some of these former fragments now appear rounded this evidence is probably of little significance. There are a few scattered patches of clay some with subrectangular outlines and these possibly represent former feldspar crystals. In another area there is a zone of fine and even grained quartzite with an apparently rounded

boundary clearly defined by a film of fine-grained iron oxide. Within this former rounded fragment or pebble relict textures marked by accumulations of very fine-grained hematite suggest that there were once rounded detrital grains averaging 0.1 mm in size and this could therefore have been a fragment of quartzite or sandstone.

Monazite crystals, the largest being 0.8 mm long and several crystals of specular hematite were fractured before the remainder of the rock was replaced by quartz.

Origin and History:

This appears to have been a moderately coarse-grained fragmental rock possibly conglomeratic and containing some feldspar, quartz and probably some monazite as well as other constituents of which no remnant now remains, but because of extensive alteration and replacement this suggestion must be regarded as a very tentative interpretation only. The rock was partly replaced by specular and ochreous hematite some of which pseudomorphously replaced or defined the earlier fragments and textures. The origin of the monazite remains uncertain but as some is enclosed by hematite it was present before crystallization of the specular hematite. There was some fracturing and all minerals other than hematite, monazite and minor amounts of feldspar? were replaced by fine to medium grained quartz.

Sample: P1535/75, R.B.M. 25/75, TSC14088.

RS120

Location:

North Flinders, Run No. 18, Photo No. 06, Sample Locality ⑦_{sp}
North of Mt. Ward.

Rock Type:

Arkose or arkosic sandstone with some larger lithic fragments.

Hand Specimen:

This rock contains some pink and grey rock fragments up to 2 cm in size scattered through a finer grained, red to greenish yellow-stained matrix.

Thin Section:

A visual estimate of the constituents is as follows:

	<u>%</u>
Detrital quartz	30-40
Feldspar (mainly microcline)	10-15
Muscovite	1-2
Large lithic fragments	15-20
Opaque oxide (some hematite fragments)	trace-1
<i>2 detrital</i> } <u>Zircon</u>	trace
} <u>Monazite</u>	minute trace
Interstitial chlorite stained by iron oxide	25-30
Interstitial <u>fluorite</u>	1-2

This rock contains some relatively large angular fragments 0.5 to several millimetres in size composed mainly of quartz and microcline and one of coarse-grained silicified rock with some apatite. These are scattered through a matrix of arkosic sandstone composed of moderately well sorted subrounded to angular grains of quartz, microcline, a few muscovite flakes and a few heavy mineral grains generally within the size range 0.05-0.15 mm with a few outside of these limits. The grain size of this matrix is fairly uniform throughout the section and in general there is little evidence of parallel orientation of elongate fragments and mica flakes.

Interstices throughout the rock contain very fine-grained pale yellowish-green chlorite of authigenic origin which has been lightly stained by orange to brown iron oxide. This chlorite also occurs along most grain boundaries and therefore there is generally little evidence of welding and interpenetration of detrital grains. Some interstices contain small patches of fluorite generally between 0.02 and 0.05 mm in size and most of these show traces of lilac staining which in very few places outlines crystal growth zones. Most of this fluorite is surrounded by chlorite but locally it is associated with a little secondary or interstitial quartz.

Origin and History:

This is a sedimentary rock containing some larger fragments of locally derived immature sediment in a matrix of moderately well sorted more mature detrital material. The rock is cemented mainly by chlorite and there is no evidence of metamorphism. The significance of the trace amounts of fluorite in the matrix is not clear.

Sample: P1536/75, R.B.M. 31/75, TSC14089.

RS121

Location:

NF/17/88/⑨₃ Mt. Painter. east of summit

Rock Type:

Silicified, layered sediment.

Hand Specimen:

A hard, fine-grained, orange-yellow to brown siliceous rock in which well defined, parallel layering and original textures and grain sizes are defined by variations in colour.

Thin Section:

A visual estimate of the constituents is as follows:

	<u>%</u>
Quartz	>95
Ferric oxide staining	up to 5

There may be some clay obscured by the ferric oxide.

The rock is now composed of an interlocking mosaic of quartz crystals 0.05-0.1 mm in size and this is uniform throughout the section. Earlier textures are marked by variations in the amount and colour of ferric oxide staining included within this secondary quartz. These relict textures show that this was a well bedded sediment composed of parallel layers generally between 1 and 6 mm thick and a few of the thicker layers apparently contained some elongate fragments of reworked bottom sediments. The relict textures also suggest graded bedding with a maximum grain size of 0.1-0.2 mm but even in these coarser grained parts of layers no evidence could be found to definitely indicate the former presence of detrital quartz grains. Therefore although the relict layering and grain size is reasonably well preserved it is not possible to determine the original composition of this sediment. It is most unusual for a silicified siltstone not to have at least some evidence of detrital quartz grains preserved and therefore the possibility that this may have been a carbonate sediment must be considered. The general mosaic texture now shown by the quartz is in fact very similar to that found in carbonate rocks.

Origin and History:

This was a moderately fine-grained layered sediment with some evidence of graded bedding and some layers of intra-formational

conglomerate. It has been completely replaced by quartz and original textures are now defined only by iron oxide staining. The original composition cannot be determined but it is possible that it was a carbonate rock.

Sample: P1537/75, R.B.M. 54A/75, TSC14090.

RS 122

Location:

NF/20/45 (11). Hematite Valley Prospect.
SP

Rock Type:

Hematitic and feldspathic sandstone (recrystallized).

Hand Specimen:

A dark greyish-red sandstone with no well defined bedding but with a suggestion of a few coarser-grained layers up to 2 cm thick.

Thin Section:

A visual estimate of the constituents is as follows:

	<u>%</u>
Quartz	>75
Potash feldspar (microcline)	5-10
Specular hematite	5-10
Grains replaced by ochreous hematite	1-2
Sericitic grains	2-3
Apatite 2 ^u	trace
Interstitial sericite	2-3
Muscovite flakes	trace
<i>detrital</i> <u>Monazite</u> <i>Zircon</i>	trace

This rock was originally a medium-grained to moderately coarse-grained sandstone probably composed largely of detrital quartz but also containing some detrital grains of potash feldspar, muscovite flakes and some grains now replaced by sericite and a few now replaced mainly by ochreous hematite. There were also a few heavy mineral grains mainly zircon and probably monazite. There are traces of sericite in some former interstices but in general these now contain quartz much of it probably overgrowths on detrital quartz grains.

There are very numerous fragments of tabular crystals of hematite but it is not clear whether these were originally constituents or whether the hematite crystallized simultaneously with much of the interstitial quartz. Much of the quartz has recrystallized and original textures are not very clearly

preserved except where some grain boundaries are defined by films of very fine-grained hematite. A few former grains and/or fragments have been almost completely replaced by very fine-grained hematite. The section contains one relatively large patch of monazite up to 0.6 mm across associated with a large irregular patch of fine-grained hematite and it may be that this was a larger fragment included within the sandstone. Smaller angular fragments of monazite are scattered sparsely through the rock and there are a few small crystals of apatite which may have crystallized with the secondary or recrystallized quartz.

Relict textures also suggest the former presence of very few lithic grains or fragments up to 0.6 mm in size composed of fine-grained rock possibly siltstone or meta-siltstone.

Origin and History:

This was probably a poorly sorted sandstone composed of quartz, feldspar and some lithic grains or fragments and a few heavy mineral grains. It has been cemented largely by secondary quartz which may have at least partly recrystallized and it is not clear whether or not the specular hematite now present was an original constituent or crystallized with the quartz.

Sample: P1538/75, R.B.M. 50A/75, TSC14091.

RS 123

Location:

NF/17/86/④ East Painter No. 4 Mine Adit.
sp

Rock Type:

Weathered hematitic breccia with a trace of torbernite.

Hand Specimen:

The rock contains some angular fragments 5-20 mm in size in a fine-grained dark red matrix. Many of the fragments have been extensively replaced by almost white clay and locally this is associated with traces of green torbernite. Some torbernite also fills very small voids and some has replaced a few grains or fragments 1-2 mm in size.

Thin Section:

The larger angular fragments or clasts are composed mainly of coarse-grained quartz and microcline and some have patches of clay and sericite which have replaced undetermined minerals.

The matrix contains some grains or fragments of quartz, a few of microcline and many which have been replaced by clay or chlorite. There are also very numerous tabular crystals or fragments of hematite, a few angular fragments of monazite and very few grains of zircon. These are now cemented by clay more or less heavily stained by red ferric oxide. It is possible that this matrix is a sedimentary siltstone or argillaceous sandstone but because of the extensive alteration it is not possible to confirm this from the thin section. Many elongate fragments of hematite and of quartz in the matrix show subparallel orientation suggesting a direction of bedding but this also is not absolutely certain.

Origin and History:

The origin cannot be determined with certainty but possibly it is a sedimentary breccia with a siltstone matrix, however, there has certainly been some fracturing and movement under conditions of tectonic stress and this together with the extensive weathering has obliterated much of the evidence of origin.

Sample: P1539/75, R.B.M. 50C/75, TSC14092.

RS 124

Location:

NF/17/86/④ East Painter No. 4 Mine Adit.
5

Rock Type:

Hematitic breccia containing some oxidized pyrite and torbenite

Hand Specimen:

A dark reddish-grey rock composed largely of crystalline hematite with a few partly leached crystals of pyrite and a few voids from which pyrite crystals have been completely leached. Yellowish jarosite? has partly replaced some of this pyrite. A few very imperfectly preserved relict textures in hematite suggests that this was a fragmental rock or a very coarse-grained sediment with fragments up to several millimetres in size. Traces of torbernite encrust the weathered surface.

Thin Section:

A visual estimate of the constituents is as follows:

	<u>%</u>
Hematite and minor pyrite	65-75
Quartz	20-30
Jarosite	2-3 (possibly more)
<u>Monazite</u>	trace
Torbernite	trace

The thin section shows a confused and porous mass of fine to medium-grained specular hematite in which very little evidence of earlier textures can be detected. There are a few dense patches 2-4 mm in size which may represent former clasts but this is little more than speculation. Many interstices in this hematite mass contain crystals and aggregates of quartz.

Scattered through the section there are leached voids and boxworks with external shapes typical of those derived from pyrite crystals. These vary in size from <0.5 mm to 3 mm and most of the larger ones have been lined with jarosite whereas some smaller ones have been completely replaced by jarosite. Locally a trace of torbernite is associated with some colloform jarosite replacing a large pyrite crystal. There is one leached void which now contains only torbernite and the identity of this leached mineral cannot be determined.

A few small angular fragments and aggregates of monazite are scattered through the section and most of these are enclosed by hematite.

Origin and History:

This rock has been almost completely replaced by hematite, quartz and pyrite and although some relict textures suggest that it contained fragments up to a few millimetres in size its origin cannot now be determined. Much of the pyrite has been oxidized and leached or replaced by jarosite and there are also traces of torbernite.

Sample: P1540/75, R.B.M. 32/75, TSC14093.

RS 125

Location:

NF/17/88/⑩₅ Mt. Painter Summit.

Rock Type:

Quartz-hematite breccia (probably tectonic).

Hand Specimen:

A coarse breccia containing angular rock fragments up to 4 cm in size in a fine-grained red ferruginous matrix. The clasts are composed of varying proportions of quartz and specular hematite and a few show evidence of banding or layering possibly from a composite quartz-hematite vein. Some clasts are composed wholly of quartz and very few appear to be predominantly hematite. The general appearance of the rock is more suggestive of a tectonic than a sedimentary breccia.

field evidence shows sedimentary

Thin Section:

A visual estimate of the constituents is as follows:

	<u>%</u>
Quartz	60-70
Hematite	30-40
<u>Monazite</u> <i>debrital</i>	trace
Clay? possibly obscured by hematite	

This contains some angular fragments composed of coarse-grained, probably vein quartz and some of similar quartz intergrown with varying proportions of specular hematite. Most of these fragments appear angular and they are scattered at random through a finer grained matrix composed of fragments of quartz, tabular crystals and fragments of hematite, a few patches of turbid silicified clay and very few angular fragments of monazite. These smaller matrix fragments average between 0.05 and 0.2 mm in size and they are cemented by a turbid mass of very fine-grained quartz and possibly some clay heavily stained and partly obscured by ochreous hematite. Many of the small fragments comprising much of the matrix are similar in composition and texture to the larger clasts and are almost certainly crushed fragments of the same rock which had been replaced by quartz and hematite. The nature of the original rock which had been replaced by these two minerals probably before extensive fracturing cannot be determined as no relict textures are preserved.

The section contains a few hematite pseudomorphs after partly leached cubic crystals of pyrite up to 0.5 mm in size.

Much of the fine-grained quartz replacing the turbid matrix appears to be a result of silicification after crushing and fracturing.

Origin and History:

This is almost certainly a tectonic breccia composed mainly of fragments of rock which had been replaced by quartz and hematite.

The fine-grained matrix heavily stained by ochreous hematite shows evidence of silicification.

Sample: P1541/75, R.B.M. 31/75, TSC14094.

RS 126

*check pet application because
P1536/75 has same RBM 31/75*

Location:

NF/17/88/9. Mt. Painter Slopes.

Rock Type:

Silicified, fine-grained, layered sediment.

Hand Specimen:

A fine-grained hard siliceous rock in which clearly defined layering is marked by variations in colour and also in grain size. Some layers show evidence of lensing and possibly very small ripple marks and there is minor cross bedding.

Thin Section:

A visual estimate of the constituents is as follows:

	<u>%</u>
Microcrystalline quartz	>90
Hematite	3-5 (varies)
<u>Monazite</u>	trace
<u>Rutile</u>	trace
<u>Zircon</u>	minute trace

This is a fine-grained, layered sediment in which all minerals other than hematite and other heavy mineral grains have been completely replaced by microcrystalline quartz. Relict textures defined mainly by lines and concentrations of minute iron oxide particles suggest that some layers were siltstone and there is also some evidence of graded bedding. *Graded bedding*

Some thin layers contain concentrations of fragments of hematite including many small fragments of specular hematite crystals between 0.02 and 0.1 mm in size. Associated with these concentrations of hematite fragments there are a few angular fragments of monazite and a few very small grains of rutile and zircon and along one layer it is noticeable that concentrations of these hematite and heavy mineral grains occur preferentially in hollows between very small ripples *Ripple marks* confirming that the hematite was of clastic sedimentary origin. Slightly above the layer showing ripples there is minor evidence of cross-bedding also defined by concentrations of hematite and other heavy mineral grains. *Cross bedding*

There are some other layers in the section in which variations in staining show relict textures of bladed crystals 0.1-0.5 mm long which apparently grew with random orientation in some layers. These former crystals have been replaced by clear colourless microcrystalline quartz in contrast to the turbid and orange-stained quartz surrounding them and the pattern of these former crystals suggest the possibility that they may have been gypsum or some other evaporite mineral. Where these relict textures are less concentrated they appear to project down into the former sediment layer from the surface of a layer. One layer just below these relict textures contains one small (0.1 mm) patch of barite? but there is insufficient of this for its identity to be determined with certainty.

Origin and History:

This was a fine-grained sediment, probably mainly siltstone which had some ripple marks, cross-bedding and graded-bedding. Some layers contain concentrations of heavy mineral grains and fragments mainly specular hematite and minor angular monazite probably derived from local rocks and it is clear that rocks containing an unusual amount of specular hematite and monazite were being eroded at the time this sediment was deposited.

There is some evidence to suggest that some layers in this sediment also contained either gypsum or some other evaporite mineral.

All of the sedimentary material other than hematite and heavy mineral grains have been replaced by microcrystalline quartz.

Sample: P1542/75, R.B.M. 51/75, TSC14095

RS 127

Location:

NF/17/086 (8)_{sp} East Painter. "Dyke" of breccia between NO.1 & NO.3 workings

Rock Type:

Breccia probably sedimentary.

Hand Specimen:

A coarse breccia containing some large clasts 1-5 cm in size in a finer grained, red, hematite-bearing matrix. On the cut surface one large clast of pink feldspathic rock and one of white quartz show apparently rounded outlines.

Thin Section:

The large clasts are composed of varying proportions of coarse-grained quartz and microcline with a few small patches of muscovite and locally some hematite. One of these large clasts composed of quartz and microcline also contains one relatively large crystal of monazite over 0.5 mm in size and this is associated with some hematite in portion of the rock which shows some evidence of silicification by coarse-grained quartz. Some of these larger clasts appear angular and others appear partly rounded but some boundaries have clearly been modified by subsequent corrosion by the matrix and also by minor but close fracturing.

The matrix appears to be a siltstone containing an abundance of specular hematite crystals and fragments. It contains scattered quartz grains and/or fragments 0.05 to 0.15 mm in size, a few angular fragments of microcline, very few of monazite and a few grains of rutile. There are scattered flakes of muscovite, a few patches of sericite and clay and it is cemented by turbid indeterminate material probably containing clay and hematite. There are some small patches of cryptocrystalline quartz?. Some of the quartz grains in this matrix are round, but in this area where round quartz grains occur in quartz-feldspar rocks this is of little significance. Very few of the microcline fragments appear rounded or partly rounded and all hematite and monazite fragments appear angular. Some interstices in the matrix have been filled by quartz.

Origin and History:

This was probably a sedimentary breccia in which the larger clasts were derived from rock composed mainly of quartz and microcline. The matrix differs in composition in that it contains an abundance of hematite much of it probably of clastic origin.

There has been some fracturing after consolidation of this rock and this has modified some boundaries of some clasts.

Sample: P1543/75, R.B.M. 52/75, TSC14096.

RS 128

Location:

NF/17/086/①. East Painter. Above No. 1 workings

Field: contact hematite breccia \pm granite. - this pet. says granite is breccia.

Rock Type:

Breccia in which the matrix has been replaced and cemented by quartz.

Hand Specimen:

A pink and dull grey rock with a poorly defined coarse fragmental appearance. On one surface there is a layer rich in hematite.

Thin Section:

A visual estimate of the constituents is as follows:

	<u>%</u>
Quartz	50-60
Microcline	30-40
Hematite	3-5 (more locally)
Muscovite	1-2

The rock contains some large clasts several millimetres in size some of which are composed almost entirely of quartz and others of microcline or of microcline intergrown with quartz. One clast composed of relatively fine-grained quartz has thin streaks and layers containing fine-grained muscovite and it is possible that this is a micaceous quartzite derived from sandstone. There are other quartz-rich clasts which have a gneissic texture defined by elongate grains and aggregates of quartz and some of microcline.

The rock also contains numerous smaller fragments of microcline 0.1-0.5 mm in size and scattered flakes of muscovite up to 0.2 mm in size. The matrix also contains scattered concentrations of specular hematite crystals or fragments generally <0.1 mm in size. Most of the microcline fragments are angular but a few appear partly rounded although this is of little significance. Interstices between these fragments have been filled by relatively clear quartz with some orange to brown iron oxide staining marking some former grain boundaries. This quartz surrounds and encloses much of the hematite and also the microcline fragments. Some is in optical continuity with quartz in larger clasts.

The surface layer of hematite-rich material contains abundant specular hematite and some scattered quartz crystals and also a few hematite pseudomorphs after pyrite? crystals 0.5-0.8 mm in size which now show internal colloform textures. This layer also contains a few small fragments of microcline and composite fragments of microcline and quartz. A few small

voids contain secondary micaceous minerals. Much of this hematite occurs as crystalline aggregates of specular or tabular crystals and there is no evidence to suggest that it had a clastic origin. Adjacent to this layer some hematite has penetrated into the rock along boundaries between former clasts and fragments.

Origin and History:

This breccia is composed predominantly of fragments derived from rock containing coarse-grained quartz and microcline and possibly some recrystallized quartzite. No conclusive evidence was found to show whether it was of tectonic or sedimentary origin. The matrix contains more abundant hematite than the clasts and it has been cemented and replaced by quartz. Specular hematite in the surface hematite-rich layer crystallized in situ and some has penetrated along boundaries between the original clasts.

Sample: P1544/75, R.B.M. 54B/75, TSC14097.

RS129

Location:

NF/20/45/11. Hematite Valley Prospect.
5P

Rock Type:

Silicified breccia.

Hand Specimen:

A dark red and grey rock with a fragmental appearance defined mainly by variations in colour. It contains a few clasts of white quartz up to 1.5 cm in size.

Thin Section:

A visual estimate of the constituents is as follows:

	<u>%</u>
Quartz	>70
Hematite	5-10 (varies)
Microcline	3-5
Sericite and clay	10-15
<u>Monazite</u>	trace
<u>Muscovite</u>	trace
<u>Rutile</u>	trace
<u>Apatite</u> formaline	trace

detr-rital {

Much of this rock has been replaced by quartz of varying grain size and this has obliterated most of the original textures. There are some zones of coarse-grained quartz

free from hematite which were probably clasts and one of these has a relatively large crystal of apatite over 0.5 mm long. There are also a few angular fragments of microcline and of intergrown microcline and quartz up to 4 mm in size.

The matrix is now composed predominantly of quartz but it also contains varying concentrations of hematite and some very fine-grained hematite outlines relict textures. It also contains a few scattered fragments of muscovite, small fragments of microcline, very small fragments of monazite, apatite and very rare tourmaline. Locally there are numerous small patches of sericite.

It is of interest that this section contains one very well-rounded fragment 2 mm in diameter composed of a graphic intergrowth of microcline and quartz and this microcline is turbid and partly stained by ferric oxide. There is also another elongate fragment showing a similar graphic intergrowth of quartz and microcline but the boundary of this, although appearing rounded has begun to merge with the silicified matrix and it is no longer clearly defined.

One oval quartz clast 0.8 mm long contains a concentration of small monazite crystals and has a slightly irregular boundary marked by a concentration of fine-grained hematite. It is possible that this quartz clast has been silicified as the quartz contains some fine inclusions and traces of relict textures.

Origin and History:

This is a breccia in which conclusive evidence of origin was not found although the presence of a few well rounded fragments suggests a sedimentary origin. The matrix has been replaced by medium to fine-grained quartz but some concentrations of hematite preserve a few relict textures.

Sample: P1545/75, R.B.M. 54B/75, TSC14098.

RS 130

Location:

NF/20/45(11)_{SP}. Hematite Valley Prospect.

Rock Type:

Weathered breccia probably of sedimentary origin.

Hand Specimen:

A medium-grained, pink, dark red and grey rock with a fragmental appearance and clearly containing numerous grains and clasts 2-10 mm in size. The rock is weathered and slightly friable and some feldspar has clearly been replaced by white clay.

Thin Section:

The rock is composed of varying proportions of quartz, microcline, hematite, sericite and clay with traces of biotite, rutile, monazite, zircon and goethite and a quantitative estimate would have little meaning. It is cut by one small vein containing carbonate.

The rock contains numerous grains and fragments composed of coarse-grained quartz and microcline but there are also a few other fragments of much finer grained rock and one of a fine grained breccia or sandstone containing moderately abundant hematite. Some of the fine-grained rock fragments are composed of a turbid mass of fine-grained quartz with minor hematite, a few small flakes of muscovite and some sericite and clay. Some maybe fragments of siltstone but others show no clear indication of origin.

Fragments in this breccia appear to have been closely packed and the remaining voids have been filled by quartz which has locally replaced parts of the matrix. A little authigenic feldspar is intergrown with some of this quartz and these two minerals also occur along a few small veins one of which contains some carbonate in the centre.

There are a few small angular fragments of monazite one closely associated with rutile.

Origin and History:

This breccia is similar to others in that is composed mainly of fragments containing quartz and microcline but there are also a few "foreign" fragments of much finer grained rock which strongly suggests that this was a sedimentary breccia. Parts of it have been replaced by quartz.

Sample: P1546/75, R.B.M. ^{56A} 56/75, TSC14099..

RS 131

Location:

NF/20/45/22_{sp} 'Dyke' to north of Haematite Valley Prospect.

Rock Type:

Hematite-rich breccia probably of sedimentary origin.

Hand Specimen:

A fragmental rock containing some very large clasts 2-5 cm in size scattered through a much finer grained matrix which contains a high proportion of specular hematite.

Thin Section:

The rock is now composed predominantly of quartz and hematite with minor muscovite, a trace of microcline and very few grains of zircon and monazite?.

The large clasts included in the section vary in size from 2 mm to over 10 mm and they are composed predominantly of coarse-grained quartz with minor muscovite. One contains at least 10% of opaque oxide grains 0.1-0.3 mm in size and some of these show external shapes suggesting that they may originally have been magnetite. One of these opaque oxide crystals encloses some small grains of zircon. Another clast consist of a loose or porous aggregate of coarse-grained quartz with interstices filled by fine-grained muscovite slightly stained by iron oxide.

The matrix has been almost completely replaced by specular hematite and quartz. There are numerous relict fragments and/or crystals 0.5-1.5 mm in size which are now composed of hematite but some show external shapes suggesting that they were originally crystals of some cubic mineral. Magnetite or pyrite appear to be the most probably but there are other possibilities. Between these hematite pseudomorphs after crystals of a cubic mineral there are numerous small aggregates and crystals of specular hematite, a few small flakes and patches of sericite or fine-grained muscovite, and very few fragments of monazite all enclosed and cemented by late or secondary quartz which has filled all interstices and replaced all other minerals. Some specular hematite also occurs within the outer zone of a few larger clasts and it is possible that at least some of this has been included in quartz overgrowths on the larger clasts but some hematite may have penetrated along grain boundaries in some fragments. Only one fragment of microcline 1.5 mm in size was found in the matrix and this appears to have been partly replaced by hematite.

Origin and History:

The origin of this breccia cannot be determined with absolute certain but it was very probably sedimentary. The fine-grained matrix has been almost completely replaced by specular hematite and quartz probably under some conditions of hydrothermal activity.

Barite seen in o/c but not in section

Sample: P1547/75, R.B.M. 62/75, TSC14100.

RS 132

Location:

NF/19/38/13. Yudnumutana Gorge. ~~at~~ waterhole near mouth

Rock Type:

Weathered breccia.

Hand Specimen:

A weathered and friable rock which shows some evidence of a fragmental texture and is composed mainly of pink feldspar with a few fragments of grey quartz. There are a few small veins and patches of fine-grained clay and sericitic material.

Thin Section:

The rock is composed predominantly of microcline with relatively minor quartz, sericite and clay and a few flakes of muscovite. Because of the weathered and friable nature of the specimen the thin section does not show any very clear evidence from which to determine the origin.

There are some relatively large fragments composed of coarse-grained microcline and very few composed of medium-grained quartz with minor partly altered biotite and muscovite in some interstices. From the thin section it is not possible to determine whether these fragments are rounded or not.

The matrix is now composed mainly of fine-grained secondary or recrystallized quartz and sericite with some small patches of microcline and this has been modified to some extent by the presence of small veinlets of quartz. It is possible that the original breccia has also been subjected to some crushing before the matrix was finally cemented by quartz.

Origin and History:

It is not possible to determine the origin of this breccia from the evidence available. Probably the originally ~~breccia~~ breccia composed largely of microcline with some quartz was subjected to later tectonic stress and the matrix was then veined and extensively replaced by quartz. Extensive weathering has obliterated many of the finer details.

Sample: P1548/75, R.B.M. 61/75, TSC14101.

RS 133

Location:

NF/19/38/13^s Yudnumutana Gorge. near mouth

Rock Type:

Silicified quartz-feldspar rock. Gneiss or pegt

Field: brown red leucogranite or volcanic

replace breccia
by granite or gneiss
and the conclusion
makes a lot of
sense.

Hand Specimen:

A medium-grained pink rock containing moderately abundant quartz intergrown with very fine-grained pink material. There are a few scattered aggregates of small dark reddish-grey opaque oxide grains. This rock does not have a fragmental appearance and there is no evidence of banding or layering.

Staining tests show no evidence of feldspar.

Thin Section:

A visual estimate of the constituents is as follows:

	<u>%</u>
Medium-grained quartz	35-45
Microcrystalline to cryptocrystalline quartz	55-65
Opaque oxide	2-3
<u>Monazite?</u>	trace-1
<u>Zircon</u>	trace
<u>Rutile</u>	trace
Muscovite	trace
Hematite staining	1-2

The rock contains uniformly scattered patches of medium-grained quartz all of which have highly irregular and embayed boundaries. These aggregates are 1-4 mm in size and there is a very slight tendency for elongated aggregates to be subparallel suggesting the possibility of a gneissic rock. The mineral or minerals which were formerly intergrown with this quartz have been completely replaced by microcrystalline to cryptocrystalline quartz which is stained orange to pink by minute particles of ferric oxide. In very few places there are faint relict textures of parallel lines or laminae included in this microcrystalline quartz suggesting the presence of former crystals with either cleavage or twinning and it is possible that these were once feldspar which was intergrown with the quartz. Very few of the larger quartz grains still contain very few inclusions of unaltered microcline which has been protected from alteration by the enclosing quartz and it is therefore suggested that at one time this medium-grained quartz was intergrown with moderately abundant microcline.

Scattered through the rock there are a few aggregates and groups of opaque oxide grains 0.1-0.3 mm in size and some of these are associated with grains or fragments of zircon, monazite and rutile. The crystal outline of some of these

opaque oxide grains indicates a former cubic mineral possibly magnetite but locally there is some evidence of recrystallization of this material to specular hematite. The largest of these aggregates of iron oxide associated with zircon, monazite? and rutile is 6 mm long, and the mineral or minerals surrounding these opaque oxide grains has been replaced by cryptocrystalline quartz. The section contains another aggregate of iron oxide which appears much more dispersed and is now composed of intergrown specular hematite crystals associated with turbid partly altered or possibly partly recrystallized monazite and a trace of zircon. This mass has been enclosed partly by microcrystalline quartz and partly by slightly coarser grained secondary quartz.

Origin and History:

This rock was probably once composed predominantly of medium to coarse-grained quartz and feldspar possibly potash feldspar and the remaining textures could be interpreted as indicating either an acid gneiss or a pegmatitic rock. It also contained some opaque oxide mineral which may have been magnetite associated with zircon and monazite?. This opaque oxide has been replaced by hematite which locally has recrystallized to aggregates of specular hematite. The feldspar and any other silicate minerals present have been completely altered (or weathered) and have been replaced by microcrystalline to cryptocrystalline quartz which is stained by red ferric oxide.

Sample: P1549/75, R.B.M. 47/75, TSC14102.

RS134

Location: Top of the Armchair
 NF/18/08/35. "The Armchair".
 SP 1

Rock Type:

Possibly recrystallized pegmatite or acid gneiss.

Hand Specimen:

A pink rock containing uniformly distributed medium-grained quartz intergrown with pink feldspar. Staining with cobalt-nitrite shows that this is potash feldspar. There is no evidence of layering and no definite evidence of a foliation.

Thin Section:

A visual estimate of the constituents is as follows:

	<u>%</u>
Quartz	35-45
Microcline	55-65
Opaque oxide	trace
<u>Sphene</u>	trace
Muscovite	trace
<u>Monazite or zircon</u>	minute trace

This contains very irregularly shaped aggregates of medium-grained quartz up to 5 mm in size intergrown with coarse-grained microcline. The boundaries between quartz and microcline are very irregular and show numerous embayments and it is of interest to note that the patterns formed by these quartz aggregates are very similar to those noted in quartz aggregates in the previous sample P1548/75. Some of these patterns show some similarity to quartz which forms as a graphic intergrowth with potash feldspar but if this was the origin of this rock the quartz has since recrystallized to a medium-grained aggregate. The microcline occurs as aggregates of large crystals with smooth to locally irregular grain boundaries and some of the crystals show evidence of shearing and deformation. Some are cut by numerous small parallel fractures. All microcline is turbid and stained red to orange by minute particles of iron oxide.

There are a few very small patches of fine-grained muscovite mainly along some grain boundaries and also very small groups of opaque oxide grains and some sphene. One small crystal or fragment of either monazite or zircon was found included in some microcline.

The textural evidence suggests that this is a pegmatitic rock which may originally have been composed predominantly of graphic intergrowth of quartz and potash feldspar. There has clearly been some recrystallization under conditions of tectonic stress and the quartz now occurs as irregular and elongate aggregates and some microcline shows evidence of deformation and fracturing. However it may also be acid gneiss (of samples P1552, 1553/75).

Sample: P1550/75. G.J.A.⁵³ TSC14103.

RS 135

Location:

NF/18/07/3.

Rock Type:

Breccia of undetermined origin.

Hand Specimen:

A pink rock containing some medium to coarse-grained quartz and abundant pink feldspar. Parts of the rock have a fractured and fragmental appearance but weathering has obscured much of the finer detail and some parts of the rock are now friable.

Thin Section:

The rock is now composed predominantly of coarse-grained quartz and coarse-grained microcline and the relative proportions of these two minerals vary in different places. There are also traces of opaque oxide, muscovite, monazite and very fine-grained rutile or sphene.

There are some large patches of quartz over 5 mm in size which have been partly granulated and recrystallized. There are other patches of medium-grained quartz which contain as inclusions a few apparently corroded remnants of microcline, a few opaque oxide grains, some small remnants of muscovite and biotite and also patches where relict textures are outlined by minute impurities such as particles of iron oxide and mica. This quartz has clearly migrated and recrystallized and has replaced some earlier minerals and where it has partly filled a void it has developed good crystal faces.

There are some patches of coarse-grained microcline showing complex intergrowths with quartz but all of these are bounded by recent fractures and whether they are fragments or pebbles cannot now be determined.

There is one patch of moderately fine-grained, extensively altered mica stained by iron oxide. There are also some irregularly elongate aggregates or clouds of very fine-grained recrystallized leucoxene (possibly rutile) included within some of the secondary quartz which has probably replaced interstitial matrix.

Origin and History:

Because of the obviously recrystallized, crushed and weathered state of this rock it is not possible to determine its origin from the thin section or hand specimen.

Sample: P1551/75. G.J.A.⁵⁹ TSC14104.
RS 136

Location:

NF/18/09/0.14

Rock Type:

Partly recrystallized arkosic breccia.

Hand Specimen:

A medium-grained pink rock composed predominantly of quartz and feldspar. The composition appears fairly uniform and in general there is no recognizable textural evidence to indicate origin however, the cut surface shows portion of one quartz grain or fragment 5 mm in size which shows an apparently rounded outline.

Thin Section:

A visual estimate of the constituents is as follows:

	<u>%</u>
Quartz	40-50
Microcline	50-60
Muscovite	1-2
Zircon <i>detrital</i>	trace
Iron oxide staining	2-3

Much of the rock is now composed of a confused intergrowth of quartz and microcline and although some quartz is coarse-grained and probably formerly present as fragments there is an abundance of finer grained quartz showing traces of fibrous texture which has clearly filled numerous voids and interstices and has probably replaced much of the matrix. Some zones composed predominantly of coarse-grained microcline contain scattered flakes of muscovite and there is another area 3 mm in size which is composed mainly of moderately fine-grained quartz intergrown with flakes of muscovite and this area is surrounded by a rim of microcline also containing muscovite flakes. *absolutely*

It is not possible to determine the origin of this breccia from the present textures and it is clear that not only quartz but microcline crystals have also grown after the rock was brecciated or accumulated. There are numerous microcline grains and/or fragments 0.1-0.4 mm in size which are surrounded or partly surrounded by overgrowths some of which have developed good crystal faces. In some zones former grain boundaries are marked by lines or concentrations of very fine-grained iron oxide and although the shape of a few of these microcline grains outlined by iron oxide appears rounded this evidence is not very convincing. Interstices between these microcline grains with and without overgrowths have been filled by quartz showing some evidence of fibrous and radial textures.

Very few zircon grains were found in the section and one included in the secondary or interstitial quartz appears rounded.

Origin and History:

This is an arkosic breccia in which there has been some recrystallization and regrowth of both quartz and microcline. There is some tenuous evidence for a sedimentary origin but this is not considered to be very conclusive.

Sample: P1552/75. G.J.A. TSC14105.

RS 137

Location:

NF/19/38/1.

Rock Type:

Weathered acid or granitic gneiss.

Hand Specimen:

A weathered pink rock composed predominantly of intergrown quartz and weathered feldspar which has been very extensively replaced by orange to red-stained clay. Adjacent to the surface much of this clay has been bleached white.

Thin Section:

A visual estimate of the constituents is as follows:

	<u>%</u>
Quartz	40-50
Iron oxide-stained clay (altered feldspar)	50-60
Muscovite-sericite	2-3
Zircon	trace
Monazite?	trace

The sample now consists of elongate and irregularly shaped aggregates of medium-grained quartz intergrown with former feldspar which has been completely replaced by iron oxide-stained clay, in which relict textures show that it was moderately coarse-grained and had some twinning. Probably this feldspar was microcline and some grains contained small round inclusions of quartz. Some grain boundaries between quartz and former feldspar are smooth and curved but in many places they are highly irregular and the quartz shows numerous embayments and this texture is very similar to that noted in the two samples P1548/75 and 1549/75. There is very slight evidence of subparallel orientation of some elongate aggregates of quartz suggesting a weak foliation.

There are a few small patches of fine-grained muscovite and sericite generally along grain boundaries or in interstices


between quartz and altered feldspar. There are also a few grains of zircon now surrounded by clay and possibly a minute trace of monazite. Without further tests this cannot readily be distinguished from the zircon. Some zircon grains appear rounded but it is felt that this is not of any great significance as apparently rounded zircons are not uncommon in granitic gneiss.

Origin and History:

This rock is probably best classified as a weathered granitic gneiss or acid gneiss and whether it is a plutonic rock or metasediment is not known with certainty. (See sample P1553/75).

Sample: P1553/75. G.J.A. TSC14106.^{S/}
RS 138

Location:

NF/18/09/3 

Rock Type:

Partly recrystallized arkosic sandstone.

Hand Specimen:

A moderately fine-grained rock composed of pink feldspar, quartz and very pale yellowish-green clay or sericitic material. A freshly fractured surface shows an even grained, sandstone-like texture.

Thin Section:

A visual estimate of the constituents is as follows:

	<u>%</u>
Quartz	35-45
Microcline	35-45
Grains replaced by sericite	15-20
Opaque oxide	trace-1
Zircon	minute trace
Muscovite	trace

In some zones this rock is composed of a granular mosaic of quartz, microcline, and grains which have been replaced by sericite and minor iron oxide. Most of the grains are between 0.2 and 0.4 mm in size and they are now intergrown with smooth grain boundaries. Many of the grains appear to have been well rounded and there is abundant evidence of interpenetration probably as a result of compaction. It is clear that some rounded grains now composed of sericite were probably a much harder mineral when this compaction and inter-

penetration occurred as some of these show little or no evidence of deformation. Some microcline grains show small overgrowths and these have filled a few small interstices.

One grain was found with its boundary and much of the internal material heavily stained by orange to red iron oxide and this shows internal textures different from all other grains noted in the section. It is 0.2 mm in size with an apparently sub-rounded outline and its presence tends to confirm the sedimentary origin of this rock.

Throughout much of the section many quartz grains have coalesced and partly recrystallized to form highly irregular patches of almost optically continuous quartz with very numerous embayments in which there are microcline grains and grains replaced by sericite. The patterns formed by these patches of recrystallized quartz is very similar to that noted in samples P1548, 1549 and 1552/75 and it therefore may provide some clue to the history of those rocks. In this sample (P1553/75) the small microcline and sericitic grains have not recrystallized to coarse-grained feldspar such as that found in sample P1549 and 1552/75.

There are very few small zircon grains scattered through this rock and most of these appear rounded. There are also groups and aggregates of small opaque oxide grains locally associated with traces of recrystallized leucoxene and most of these aggregates are in patches of sericite. The reason for this is not clear.

Origin and History:

Textural evidence indicates that this was a well sorted arkosic sandstone composed mainly of quartz and feldspar but the identity of grains now replaced by sericite and iron oxide is not known-possibly some were plagioclase. Compaction caused interpenetration of many grains and there has been some regrowth of microcline. Some of the quartz has coalesced and recrystallized to highly irregular patches of almost optically continuous quartz. The similarity of textures shown by quartz in this rock and in samples P1548, 1549 and 1552/75 may provide some clue as to the origin and history of those rocks.

Sample: P1554/75. G.J.A.⁵⁷ TSC14107.

RS139

Location:
NF/18/09/7.

Rock Type:

Acid gneiss probably recrystallized feldspathic sandstone.

Hand Specimen:

A pale orange yellow, generally fine-grained rock containing quartz, some feldspar and minor dark biotite. It does not show any special features or textures in the hand specimen but contains some small veins with fluorite which is locally purple. Staining tests show minor amounts of potash feldspar only along some veins.

Thin Section:

A visual estimate of the constituents is as follows:

	<u>%</u>
Quartz	40-50
Plagioclase (near An ₈)	40-50
Microcline (along veins)	1-2
Biotite	5-10
Muscovite	trace
Opaque oxide	trace
Chlorite and sericite	2-3
Fluorite (veins)	2-3
Zircon	minute trace

This rock contains patches composed of a fine granular mosaic of plagioclase intergrown with some quartz with grain sizes varying from 0.05-0.3 mm. These appear to have been composed of sand-sized detrital grains which now interpenetrate and have become welded. These patches of fine-grained mosaic are interspersed with very irregular patches of coarser grained quartz which has coalesced and recrystallized forming patches similar to the recrystallized quartz in sample P1553/75. Some of the feldspar in this rock has also recrystallized to larger optically continuous patches up to 1 mm in size and in general these contain a few remnant quartz grains. This differs from the previous sample in that the dominant feldspar is albitic plagioclase with only very minor traces or remnants of microcline.

Flakes and aggregates of pale-brown biotite locally associated with opaque oxide are scattered through the rock occurring mainly along grain boundaries and some of the coarser grained

biotite is associated with coarser grained quartz and feldspar. This has clearly recrystallized.

A very weak foliation is defined by some subparallel aggregates of biotite and by a few elongate patches of recrystallized quartz.

The rock is cut by some poorly defined veins some of which contain fluorite locally stained purple and some contain coarse-grained quartz. There are also numerous fractures and/or shearing planes along which there are concentrations of very fine-grained, iron oxide-stained chlorite or secondary mica and adjacent to these fractures microcline tends to take the place of some plagioclase.

There are very few zircon grains and one which is partly altered appears very well rounded.

Origin and History:

This could now be classified as an acid gneiss and there is some textural evidence to suggest that it may have been derived from a feldspathic sandstone. Veins contain fluorite and quartz and along some fractures some plagioclase has been replaced by microcline.

Sample: P1555/75. D.J.F. TSC14108; PSD4174.

RS140

Location:

NF/16/59/5A. East Painter No. 5 Mine Addit.

Rock Type:

Hematitic siltstone. *± graded bedding*

Hand Specimen:

A fine-grained, dark reddish-grey rock with parallel layers or laminations 1-2 mm thick. Most of these show definite evidence of graded bedding.

Thin and Polished Sections:

A visual estimate of the constituents is as follows:

	<u>%</u>
Quartz	40-50
Hematite	40-50
Muscovite/sericite	1-2
Grains replaced by clay	10-15
Zircon	trace

This is a fine-grained, sedimentary rock which has at least partly recrystallized and is now composed of a fine-grained mosaic of quartz grains intergrown with fine-grained hematite including numerous small specular hematite crystals. Relict textures suggest that this contained detrital quartz grains generally <0.05 mm in size, a few flakes of muscovite and a few rounded grains which have been replaced by sericite and clay. Layers averaging 2 mm in thickness are defined mainly by variations in grain size and most of these layers show graded bedding with an average grain size at the base of 0.05 mm grading up to some material with an average grain size of 0.02 mm near the top.

Hematite is intergrown with the quartz and some of it occurs as tabular crystals which tend to be subparallel to the bedding. The grain size of the hematite tends to vary with that of the quartz thus emphasizing the graded bedding. Some hematite occurs in interstices and some is included in secondary or partly recrystallized quartz. The origin of this hematite cannot be definitely determined from a study of the thin and polished sections and the polished section contains only relatively few hematite grains which appear to have been of clastic origin and these are surrounded by thin overgrowths of slightly porous very fine-grained hematite.

Some interstices contain small patches of very fine-grained clay and/or sericite and similar clay has also replaced a few apparently rounded grains averaging 0.02 mm in size. Some layers contain a few muscovite flakes most of which are parallel to the bedding. There are very few rounded zircon grains between 0.02 and 0.4 mm in size.

Origin and History:

This is predominantly a fine-grained clastic sediment containing thin layers which show graded bedding. It contains abundant hematite which is uniformly distributed and conclusive evidence was not found to show whether this hematite was of clastic origin or crystallized from chemically precipitated iron hydroxide.

This sediment differs from typical banded iron formation in that it contained abundant quartz and some other minerals which were clearly of clastic sedimentary origin as indicated by the graded bedding.

Has a micro-high angle thrust fault.

P1556/75 TSC 14109

Location: RS141
NF/16/59/1. East Painter Gorge.

Rock Type:
Acid gneiss showing evidence of layering.

Hand Specimen:

A pink rock with one layer 3 cm thick composed largely of coarse-grained quartz and pink feldspar sandwiched between two much finer grained layers composed of similar quartz and feldspar but with moderately abundant fine-grained dark biotite. These finer grained layers show evidence of a foliation or weak schistosity defined by subparallel orientation of much of the biotite.

Thin Section:

A visual estimate of the constituents is as follows:

	<u>%</u>
Quartz	30-40
Microcline	40-50
Biotite	15-20 (mainly in finer grained layers)
Opaque oxide	2-3 " " "
Grains replaced by sericite	2-3
Zircon monazite	trace

The coarse-grained layer is composed predominantly of microcline with lesser quartz and both minerals have recrystallized and are now intergrown with mainly smooth grain boundaries and there is little or no evidence of relict textures. One large microcline crystal however, completely encloses an apparently rounded grain 0.8 x 1 mm in size which is also composed of microcline with different orientation and showing a slightly different twinning pattern. The large microcline crystal also contains a few scattered quartz grains 0.5-0.8 mm in size with and without overgrowth quartz and some faint lines of staining or impurity could be interpreted as outlining former detrital grains. This is not conclusive. Some coarse-coarse microcline has been fractured and this fracture has been filled by migratory or secondary quartz.

The finer grained layer included in the section is composed mainly of intergrown quartz, microcline and biotite with a few grains which have been completely replaced by sericite and a few elongate aggregates of opaque oxide generally associated with a few zircon grains and some monazite. Grain

size in this layer varies from 0.1-1 mm whereas in the coarse-grained layer quartz and microcline crystals are up to 1 cm in size. Probably all minerals in this finer grained layer have also completely recrystallized but there are some small inclusions 0.1-0.3 mm in size of one mineral within another which could be interpreted as indicating that this was derived from a sandstone.

Most of the biotite flakes are parallel to the foliation and layering and there are also a few elongate microcline crystals and quartz aggregates parallel to this direction. Opaque oxide occurs mainly in elongate groups or aggregates parallel to the foliation. A few small zircon grains are associated with some aggregates of opaque oxide and in one area one zircon grain is partly enclosed by some monazite which is also associated with the opaque oxide.

Origin and History:

This rock would now be classified as an acid gneiss or granitic gneiss but the evidence of layering and variation in composition and grain size in the different layers strongly suggests that it was of sedimentary origin. This could not be conclusively proved by microscopic examination.

Sample: P1557/75. D.J.F. TSCI4110.

RS142

Location:

NF/16/59/5B. East Painter No. 5 Mine Addit.

Rock Type:

Hematite-bearing siltstone and sandstone.

Hand Specimen:

A fine-grained grey rock with thin parallel layers of different grain size and composition. The finer grained layers resemble siltstone and contain abundant iron oxide, and the coarser grained layer which is up to 1 cm thick has a grain size corresponding to sandstone and contains less iron oxide.

Thin Section:

A visual estimate of the constituents is as follows:

	<u>%</u>
Quartz	50-60
Hematite	30-40
Muscovite/sericite	3-5
Clay	2-3

Zircon
Monazite?

%
trace
trace

The fine-grained layers in this sample are similar to the hematite-bearing siltstone of sample P1555/75 to which this is probably related.

The coarser grained layers are composed largely of intergrown quartz grains in which grain boundaries of the former detrital grains are marked by thin lines or concentrations of impurities and brown staining. These are included within quartz overgrowths which fill many interstices. The remaining interstices contain small patches of clay and/or sericite. Most of the detrital quartz grains were between 0.1 and 0.3 mm in size and therefore these sandstone layers were well sorted. They also contain a few grains or flakes of muscovite, very few zircon grains and very few angular grains which may be monazite.

Much of the hematite occurs as tabular crystals or fragments of crystals but there are also a few apparently rounded hematite grains. Many of these crystals occurring in interstices between the detrital grains have been included within the overgrowths of quartz now filling interstices.

Origin and History:

This is a layered sediment in which sandstone layers are composed of well sorted quartz grains and a few other minerals including some heavy mineral grains. Hematite occurs throughout the sediment but is more abundant in the finer grained siltstone layers which show some evidence of graded bedding and are very similar to sample P1555/75. As for that sample conclusive evidence indicating the origin of the hematite was not found, but the possibility that hematite-rich rocks were being eroded at the time this sediment accumulated should be considered although other interpretations are possible.

This is probably related to sample P1555/75 and it was a clastic sediment not a banded iron formation.

Sample: PI558/75. D.J.F. TSC14111.

RS 143

Location:

NF/17/092/13. Radium Ridge.

Rock Type:

Feldspar-biotite schist.

Hand Specimen:

A pink to yellowish-grey medium to coarse-grained rock in which there appears to be some fragments over 1 cm in size. Staining tests did not show any potash feldspar either as large fragments or in the matrix.

Thin Section:

A visual estimate of the constituents is as follows:

	<u>%</u>
Quartz	3-5
Plagioclase	40-50
Biotite	40-50
<u>Zircon</u>	trace-1

The rock is now composed predominantly of albitic plagioclase and biotite probably as a result of metamorphism but relict textures suggest that it once contained some large fragments probably mainly of feldspar in a finer grained matrix but the general absence of quartz cannot be readily explained.

The large clasts included in the section are composed predominantly of a single crystal of plagioclase with scattered small inclusions also of plagioclase with different optical orientation. There are also some irregular patches of partly weathered medium-grained biotite surrounded by fine-grained, iron oxide-stained chlorite or clay. Some of these patches are very similar to matrix material and it is therefore possible that at least some of these large plagioclase crystals may not have been clasts but maybe porphyroblasts which have been somewhat modified by later fracturing and/or crushing.

The matrix is a confused intergrowth of patches of plagioclase showing a fine-grained granular texture and other patches composed mainly of intergrown biotite crystals. There are some patches of plagioclase which appear to represent former larger crystals which have been granulated and recrystallized. Some biotite shows evidence of subparallel orientation indicating a very weak schistosity but this also appears to have

been modified by crushing or shearing and much of the biotite shows evidence of deformation or fracturing.

There are a few scattered crystals of zircon and most of these also show evidence of fracturing.

History and Origin:

This was very probably a sedimentary rock which was metamorphosed to feldspar-biotite schist. It is not certain whether the large feldspar crystals now present represent former pebbles or large phyroblasts because subsequent crushing and/or shearing have modified former textures and schistosity. The present mineral composition suggests derivation from an argillaceous sediment.

Sample: P1559/75. D.J.F. TSC14112.

RS144

Location:

NF/18/11/9. Western end of Radium Ridge.

Rock Type:

Feldspar-biotite schist.

Hand Specimen:

A grey to green, fine-grained rock with numerous larger fragments or crystals of feldspar some over 1 cm in size. Some of these appear rounded. The outer surface is stained orange to brown by iron oxide.

Thin Section:

A visual estimate of the constituents is as follows:

	<u>%</u>
Quartz	25-30
Microcline	30-35
Plagioclase	20-25
Biotite	20-25
<u>Zircon</u>	trace
Opaque oxide	1-2
<u>Apatite</u>	trace

This is similar to sample P1558/75 in that it contains some relatively large plagioclase crystals up to 10 mm in size scattered through a finer grained matrix which contains moderately abundant biotite. As in sample P1558/75 the large plagioclase crystals contain numerous small inclusions, in this case mainly of biotite and quartz and

the general impression is that these large plagioclase crystals were of metamorphic origin and not pebbles. Through one large plagioclase crystal there is a very faint suggestion of banding defined by concentrations of very small biotite inclusions and this tends to confirm their metamorphic origin.

The matrix is rather finer grained than that in sample P1558/75 and it consists of intergrown quartz, microcline, plagioclase and biotite with an average grain size of between 0.1 and 0.3 mm. Some of the biotite flakes and elongate biotite aggregates show subparallel orientation defining a very weak schistosity. In general the biotite in the matrix is noticeably coarser grained than the biotite inclusions in the large plagioclase crystals and it is probable that those included within the large plagioclase crystals were formed at an early stage and protected by the enclosing plagioclase from further metamorphism.

There are a few turbid, irregularly shaped and fractured zircon grains similar to those found in the previous sample and there are also a few grains of apatite. Locally there are some groups and porous aggregates of opaque oxide which has filled interstices and penetrates along grain boundaries enclosing a few grains of feldspar, biotite and zircon. Some of this opaque oxide has associated traces of leucoxene or sphene.

History and Origin:

This is very probably a metamorphosed sediment probably containing abundant argillaceous material. All of the large fragments examined in thin section appear to be plagioclase porphyroblasts and not pebbles and therefore it is doubtful if this was a conglomeratic rock; a general absence of quartz pebbles does not suggest a conglomerate.

Sample: P1560/75. D.J.F. TSC14113. ✓

RS 145

Location:

NF/19/35/3. Breccia Knob, Yudnumutana Gorge.

Rock Type:

Breccia very probably of sedimentary origin.

Hand Specimen:

A coarse fragmental rock containing numerous clasts of pink

feldspar and some of almost white rock in a finer grained matrix stained orange to brown by iron oxide. There is a small zone of dark fine-grained siltstone? in the hand specimen.

Thin Section:

A quantitative estimate of the mineral percentages in this rock would have little meaning and therefore it is not given.

This rock contains some large lithic fragments over 5 mm in size in a matrix composed of very poorly sorted crystal and lithic fragments <0.05 - 2 mm in size which are cemented by interstitial sericite, chlorite and clay partly stained by iron oxide.

The large fragments are composed mainly of coarse-grained quartz and microcline and have been derived probably from granitic or gneissic rocks. The matrix also contains abundant angular fragments of microcline and quartz but there are also scattered flakes of muscovite, numerous small fragments and/or crystals of hematite, a few finer grained lithic fragments probably formerly composed mainly of biotite now weathered, and a few fragments of heavy mineral grains including a few angular and subangular fragments of tourmaline. Through much of the matrix most of these small clastic fragments are between 0.05 and 0.5 mm but locally there are some pockets of much finer grained material similar to siltstone and in these zones mica flakes and some elongate mineral fragments tend to be subparallel possibly to a local direction of bedding.

Most of the mineral fragments are surrounded by a film of orange to brown-stained clay or sericitic material and throughout most of the section interstices contain very fine-grained chlorite and/or clay possibly with some sericite and much of this is also stained orange to brown by iron oxide. In very few places some interstices have been filled by secondary quartz.

Scattered through the matrix and also in some larger fragments there are a few iron oxide pseudomorphs after pyrite crystals.

Origin and History:

This is a breccia composed largely of material derived from quartz-microcline gneissic or granitic rocks and probably also some rocks containing an abundance of hematite.

Features which indicate a sedimentary origin are as follows:

1. Although most of the fragments are of quartz and microcline with the addition of mica, hematite and heavy mineral grains in the matrix there are also a few fragments which appear to be of "foreign" origin.
2. Practically all mineral and lithic fragments are separate and isolated from adjacent fragments and cannot be matched against them in shape. There are only a few places where apparently more recent fracturing is indicated by some matching fragments which have suffered little displacement.
3. The presence of a few pockets of finer grained material which is indistinguishable from siltstone.

It is therefore concluded that this is a sedimentary breccia.

Sample: P1561/75. D.J.F. TSC14114.

RS 146

Location:

NF/17/092/14. Radium Ridge.

Rock Type:

Weathered breccia possibly of sedimentary origin but the evidence is less conclusive than in sample P1560/75.

Hand Specimen:

A fragmental rock containing some large clasts over 1 cm in size composed mainly of pink feldspar and white quartz. The finer grained matrix is stained by iron oxide and does not show any distinctive features. There are a few crystals of partly oxidized pyrite scattered through the sample.

Thin Section:

Quantitative estimates of mineral abundances in this rock would have little meaning.

The larger clasts show some variation in composition in that some are composed mainly of quartz and microcline whereas others are composed of quartz and plagioclase. A few are mainly microcline with moderately abundant opaque oxide, very few are predominantly quartz and one fragment of finer grained rock appears to be metamorphosed sandstone with moderately abundant hematite. Textures within the larger clasts also vary and clearly they have not all been derived

from the same zone of rock.

Because of the results of weathering the boundaries of some fragments are not very clearly defined and there are also some patches of apparently coarse-grained plagioclase which now have very poorly defined boundaries and have been extensively veined and partly replaced by iron oxide-stained clay or chlorite similar to that present in the matrix.

The matrix is composed mainly of angular fragments of quartz, plagioclase and microcline with minor opaque oxide and a few scattered fragments of heavy mineral grains mainly tourmaline and zircon but possibly including a trace of monazite. The fragments in the matrix are poorly sorted and interstices contain very fine-grained chlorite and /or clay stained by iron oxide.

~~Minor~~ tourmaline, zircon

There are traces of secondary carbonate partly replacing some of the large plagioclase crystals and also occurring in a few fractures and in interstices. This may be a weathering feature.

Extensive weathering of this rock has probably resulted in some partial disintegration of the rock fragments around their margins and the release of some mineral grains into the adjacent matrix and because of this the fragmental texture of the rock is not clear throughout the whole of the thin section.

Origin and History:

This breccia contains material derived from different rock types and therefore it was very probably of sedimentary origin but the evidence is not as conclusive as in sample P1560/75. Many grain boundaries are no longer clearly defined probably because of more extensive weathering.